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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/531,367	04/13/2005	Avto Tavkheldze	12090	6964
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Borealis Technical Limited 23545 NW Skyline Blvd North Plains, OR 97133-9204				
EXAMINER				
GARDNER, SHANNON M				
ART UNIT		PAPER NUMBER		
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/531,367

Applicant(s)

TAVKHEDIDZE ET AL.

Examiner

Shannon Gardner

Art Unit

1795

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 July 2008 (Applicant's Arguments).
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 5 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 6-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SI/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

Applicant's amendment of 7/2/2008 does not render the application allowable.

Remarks

Applicant has cancelled claim 5. Currently claims 1-4 and 6-20 are pending in the application and are considered on their merits below.

Status of Objections and Rejections

The objection to claim 16 for claim informalities has been withdrawn in view of Applicant's arguments.

The rejection of claim 5 under 35 USC 112, second paragraph is obviated by Applicant's cancellation.

The rejections of claim 1--12, 14, 16, 18, and 20 under 35 USC 102(b) is withdrawn in view of Applicant's amendment. New grounds of rejection necessitated by amendment are presented in the action to follow.

The rejection of claims 13, 15, 17, and 19 under 35 USC 103(a) are withdrawn in view of Applicant's amendment. New grounds of rejection necessitated by amendment are presented in the action to follow.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-4 are rejected under 35 U.S.C. 102(b) as being anticipated by Tavkhelidze (US 6281514, cited in IDS).

As to claim 1, Tavkhelidze is directed to a tunnel barrier (Figure 2, (17)) comprising a potential barrier having an indented or protruded cross-section, wherein the geometry of the indents in said indented cross section or of the protrusions in said protruded cross section is stepped, and wherein walls of said stepped geometry are perpendicular to one another (see Figure for configuration; also see column 4, lines 50-60).

Claim 1 recites the tunnel barrier being "for controlling the movement of electrons through a thermoelectric material" which is directed to intended use and will therefore not be given undue weight. However, even if this were to be given weight in the claim, it is the Examiner's position that the thermionic materials utilized in '514 read on the instant thermoelectric materials and the movement of electrons through the tunnel barrier would certainly be controlled (see column 4, lines 60-67).

Regarding claim 2, the reference teaches the depth of indents in the indented cross-section or the height of the protrusions in the protrusion cross-section being chosen to set a threshold energy value above which the barrier is transparent to electron flow, and below which electron flow is prevented (column 4, line 55 to column 5, line 25).

Regarding claim 3, the reference teaches the depth of the indent in the indented cross-section being given by the relationship $(n\lambda + \lambda)/4$, where n is 0 or a positive integer (column 4, line 50 to column 5, line 10). It is the Examiner's position that for certain

values of n (i.e $n=0$), this relationship will give the same indent depth as required by the instant claim. Therefore, claim 3 is met.

Regarding claim 4, the reference teaches the integer n having a value between 0 and 4 (see claims 4 and 6-7).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims XXX are rejected under 35 U.S.C. 103(a) as being unpatentable over Ghoshal (US 20020092557) in view of Tavkhelidze (US 6281514).

As to claim 1, Ghoshal is directed to a tunnel barrier for controlling the movement of electrons through a thermoelectric material comprising a potential barrier having an indented or protruded cross-section (see Figure 14; paragraphs [0069]-[0070]; also see Figure 2; paragraphs [0042]-[0043]). Ghoshal is silent as to the geometry of the indents in the indented cross section or of the protrusions in the protruded cross section being stepped, and wherein walls of the stepped geometry are perpendicular to one another.

However, it is known in the tunnel barrier art to create a barrier with such a stepped geometry to increase electron tunneling, as taught by Tavkhelidze (Figure 2; column 4, lines 50-60).

Therefore, it would have been obvious to one of ordinary skill in the art to modify the tunnel barrier of Ghoshal with the stepped geometry of Tavkhelidze in order to increase electron tunneling.

Regarding claim 2, Tavkhelidze teaches the depth of indents in the indented cross-section or the height of the protrusions in the protrusion cross-section being chosen to set a threshold energy value above which the barrier is transparent to electron flow, and below which electron flow is prevented (column 4, line 55 to column 5, line 25).

Regarding claim 3, Tavkhelidze teaches the depth of the indent in the indented cross-section being given by the relationship $(n\lambda + \lambda)/4$, where n is 0 or a positive integer (column 4, line 50 to column 5, line 10). It is the Examiner's position that for certain values of n (i.e. $n=0$), this relationship will give the same indent depth as required by the instant claim. Therefore, claim 3 is met.

Regarding claim 4, Tavkhelidze teaches the integer n having a value between 0 and 4 (see claims 4 and 6-7).

Regarding claim 6, Ghoshal teaches the potential barrier comprising an electrical insulator; Ghoshal teaches evacuating the areas between and around the tips (250). This evacuation reads on the instant electrical insulator (paragraphs [0035]-[0036]; also paragraph [0037]).

Regarding claim 7, Ghoshal is directed to a thermoelectric device (Figure 2) comprising a first thermoelectric material (210), a second thermoelectric material (212), and one or more tunnel barriers (216, also see Figure 14 (1402)).

Ghoshal is silent as to the geometry of the indents in the indented cross section or of the protrusions in the protruded cross section according to claim 1.

However, it is known in the tunnel barrier art to create a barrier with a stepped geometry (as per instant claim 1) to increase electron tunneling, as taught by Tavkhelidze (Figure 2; column 4, lines 50-60).

Therefore, it would have been obvious to one of ordinary skill in the art to modify the tunnel barrier of Ghoshal with the stepped geometry of Tavkhelidze in order to increase electron tunneling.

Ghoshal teaches the use of tips 1402 (Figure 14) being usable in a thermoelectric cooler to provide tunneling of electrons (paragraph [0070]). The use of these tips (1402) in the thermoelectric cooler (Figure 2) taught by Ghoshal is clearly within purview of the reference.

Regarding claims 8-10, Ghoshal in view of Tavkhelidze teaches the first thermoelectric material (210) comprising an n-type material, the second thermoelectric material (212) comprising a p-type material, and a tunnel barrier (250) in electrical contact with an anode of the n-type material and a cathode of the p-type material. Applicant is invited above for a full discussion of Ghoshal in view of Tavkhelidze in reference to the geometry of the tunnel barrier of independent claim 7.

It is the Examiner's position that the tunnel barriers (250), the thermoelectric materials (210 and 212), and the electrodes taught by Ghoshal are all in electrical contact. Therefore claims 8-10 are met.

Regarding claim 14, Ghoshal in view of Tavkhelidze teaches the step of forming an indented or protruded structure comprising etching (Ghoshal; Figure 8; paragraphs [0058]-[0059]).

Regarding claim 16, Ghoshal in view of Tavkhelidze are silent as to the depth of indents in the indented cross-section or the high or protrusions in the protruded cross section being in the range of 10-100 λ . However, Ghoshal does teach the tip radius being about 50nm (paragraph [0048]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to create the device of Ghoshal modified by Tavkhelidze on the scale of the

instant claim as such would have been within purview of one of ordinary skill in the art. Further, it has been held that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device (see MPEP 2144.04).

Regarding claim 18, Ghoshal in view of Tavkhelidze teaches the first or second thermoelectric material being selected from the group consisting of: Bi_2Te_3 , Sb-doped Bi_2Te_3 , Se-doped Bi_2Te_3 , $\text{Bi}_{1-x}\text{Sb}_x$, and CoSb (Ghoshal, claims 5 and 6).

6. Claims 11-13, 17, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ghoshal in view of Tavkhelidze as applied to claims 6 and 7 above, and further in view of Saida (US 5866930).

Regarding claims 11 and 13, Applicant is directed above for a full discussion of Ghoshal in view of Tavkhelidze as applied to claim 7. Ghoshal in view of Tavkhelidze teaches a method for making the thermoelectric device comprising forming an indented or protruded structure on a surface of a first thermoelectric material and forming an electrically insulating material over the indented or protruded surface (Ghoshal; paragraphs [0037]; Figure 8; paragraphs [0058]-[0059]). ****Examiner Note:** Ghoshal teaches forming an evacuated seal in the areas between and around the tips of his device. The references are silent as to attaching a second thermoelectric material to the insulating material.

However, it is known in the art to oxidize a thermoelectric material to form an insulating layer, as taught by Saida et al. (Figure 5A-5C; column 9, lines 9-37) to create a solid insulating material that ensures structural stability of the thermoelectric device.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize thermal oxidization to form an insulating material as taught by Saida in the modified device of Ghoshal to ensure structural stability of the device and to maintain the nanometric distance between the stepped structure and the lattice structure to allow for tunneling.

Regarding claim 12, Ghoshal in view of Tavkhelidze teaches the step of forming an insulating material comprising depositing the insulating material (Ghoshal; Figure 8; paragraphs [0058]-[0059]). It would have been obvious to one of ordinary skill in the art to deposit an insulating material over the first thermoelectric material as such is extremely well known in the art.

Regarding claims 17 and 19, Ghoshal in view of Tavkhelidze is silent as to the electrical insulator being selected from the group consisting of: SiO_2 , Si_3N_4 , Al_2O_3 and titanium oxide.

However, it is well known in the thermoelectric art to utilize SiO_2 as an electrical insulator, as taught by Saidi et al. (Figure 5A (112); column 9, lines 9-37) as formation of SiO_2 is well known and easily executed.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize SiO_2 as an electrical insulator, as taught by Saidi et al. (Figure 5A (112); column 9, lines 9-37) to allow for ease of insulator formation.

Regarding claim 20, Ghoshal in view of Tavkhelidze teaches the first or second thermoelectric material being selected from the group consisting of: Bi_2Te_3 , Sb-doped Bi_2Te_3 , Se-doped Bi_2Te_3 , $\text{Bi}_{1-x}\text{Sb}_x$, and CoSb (Ghoshal, claims 5 and 6).

7. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ghoshal in view of Tavkhelidze and further in view of Saida as applied to claim 11 above, and further in view of Brannon.

Regarding claim 15, Ghoshal in view of Tavkhelidze and further in view of Saida is silent as to the formation of an indented or protruded structure comprising ablation.

However, it is known in the art that ablation and etching are substantially similar and essentially interchangeable (Brannon; pp 11, 2nd column to pp 12, 2nd column).

Therefore, the formation of an indented or protruded structure by either etching (Ghoshal, Figure 8) or ablation would produce a substantially similar result; the use of either would clearly be within the purview of one of ordinary skill in the art. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Response to Arguments

7. Applicant's arguments regarding the relevance of the prior art on the basis of publication date, see pp 5-6, filed 7/2/2008, with respect to the rejection(s) of claim(s) 1-2, 6-12, 14, 16, 18, and 20 under Ghoshal (WO 02/47178) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon

further consideration, a new ground(s) of rejection is made in view of Ghoshal (US 20020092557), etc.

8. Applicant's arguments, see pp 5, filed 7/2/2008, have been fully considered and are persuasive. The objection of 16 has been withdrawn.
9. Applicant's arguments filed 7/2/2008 with respect to Tavkhelidze have been fully considered but they are not persuasive:

Applicant argues that "in point of fact, Figure 2 is a diagrammatic representation of a notional surface 17 separating two domains" and "there is no detailed teaching that such a surface may be used to control the movement of electrons through a thermoelectric material" (pp 8).

The Examiner respectfully disagrees. Applicant is reminded that the limitation in claim 1 of "for controlling the movement of electrons through a thermoelectric material" is considered functional language and is not given patentable weight in the claim. Further, Tavkhelidze teaches "a potential barrier having a geometrical shape for causing de Broglie interference" (abstract) and reflects this geometric shape in further figures (see Figure 5).

10. Applicant's arguments filed 7/2/2008 with respect to Ghoshal in view of Saida have been fully considered but they are not persuasive:

Applicant argues "there is no suggestion or motivation to provide an electrical insulator...in the gap between the tips and opposing surface...as taught by Saida" (pp 9).

The Examiner respectfully disagrees. Ghoshal teaches sealing the spaces between the tips and the opposing surface (paragraph [0040]). Should these spaces be evacuated, this evacuation serves as electrical insulation. Clearly one reading the Ghoshal reference as a whole would understand that the addition of SiO₂ instead of evacuation is within purview of one of ordinary skill.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shannon Gardner whose telephone number is (571)270-5270. The examiner can normally be reached on Monday to Thursday, 8am-5pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571.272.1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. G./
Examiner, Art Unit 1795

/Alexa D. Neckel/
Supervisory Patent Examiner, Art Unit 1795